We claim:

1. A method of anisotropically etching a substrate assembly, comprising:

forming a resist layer on a surface of the substrate assembly, the resist layer having a thickness;

defining patterns in the resist layer by removing portions of the resist layer; and

exposing the resist layer and the surface of the substrate assembly to a plasma etch and simultaneously etching a portion of the substrate exposed by the step of removing portions of the resist layer and increasing the thickness of the resist layer with the plasma etch.

2. The method of claim 1, wherein the step of simultaneously etching a portion of the substrate assembly and increasing the thickness of the resist layer is performed by exposing the surface of the substrate assembly to a plasma generated in a gas mixture consisting essentially of a fluorinated, chlorinated, or hydrogenated hydrocarbon gas.

3. The method of claim 2, wherein the gas mixture consists essentially of at least one of the gases CF_4, CHF_3. CH_2F_2, CH_3F, C_2F_6, C_2HF_5, C_3F_8, C_4F_8, C_4F_6, and C_5F_8.

4. The method of claim 2, wherein the gas mixture consists essentially of CH_2F_2.

5. The method of claim 1, wherein the thickness of the resist layer is less than about 600 nm.

6. The method of claim 1, wherein the resist layer has a thickness d, and a high aspect ratio feature is etched into the substrate to a depth D such that $D/d > 5$.

7. The method of claim 1, wherein the thickness of the resist layer is a facet thickness and the plasma etch increases the facet thickness.

8. The method of claim 1, wherein the thickness of the resist layer is a nominal thickness and the plasma etch increases the nominal thickness.

9. An etched substrate assembly, comprising a silicon wafer having an etched feature having an aspect ratio of at least 10.

10. The etched substrate assembly of claim 9, wherein the aspect ratio is at least 20.

11. The etched substrate assembly of claim 9, further comprising an oxide layer formed on the silicon wafer and wherein the etched feature is etched into the oxide layer.

12. A method for plasma etching an oxide layer formed on a silicon wafer, the oxide layer partially covered with a patterned layer of a resist, the method comprising:

exposing the oxide layer and the patterned layer of resist to a gas consisting essentially of CH2F2;

generating a plasma within the gas;

directing ions from the plasma onto exposed portions of the oxide layer; and

adjusting the flow of the gas so that the exposed portions of the oxide layer are etched such that the oxide layer is etched at a rate at least five times faster than the resist.

13. The method of claim 12, wherein the patterned layer of resist has a nominal thickness and the gas flow is adjusted so that the nominal thickness decreases at a rate that is at least ten times slower than the rate at which the oxide layer is etched.

14. A method of etching a substrate assembly, comprising:

forming a resist layer on a surface of the substrate assembly;

defining a feature on the surface of the substrate assembly by patterning the resist layer so that the resist layer is removed from at least a portion of the substrate;

etching the portion of the substrate that is not covered by the resist layer and depositing a material on the resist layer with a plasma generated in a flow of a first halogenated hydrocarbon containing gas so that the etched feature has an aspect ratio of at least 5:1.

15. The method of claim 14, wherein the etched feature has an aspect ratio of at least 10:1.

16. The method of claim 14, wherein the patterned layer of resist has a facet thickness and the step of etching the substrate is resist-conserving with respect to the facet thickness.

17. The method of claim 14, further comprising etching the portion of the substrate assembly that is not covered by the resist with a plasma generated in a flow of a second halogenated hydrocarbon

containing gas that etches the surface of the substrate and the resist layer.

18. The method of claim 14, wherein the portion of the surface exposed to the plasma is etched so that the etched feature has an aspect ratio of at least 10:1.

19. The method of claim 14, further comprising forming an oxide layer on the surface of the substrate assembly, forming the resist layer on the oxide layer, and patterning the resist to expose a portion of the oxide layer.

20. A process for plasma etching a substrate assembly having an oxide layer, comprising:

defining patterns on the oxide layer with a resist;

contacting the oxide layer with a plasma generated in a gas or gas mixture consisting essentially of a halogenated hydrocarbon gas, the halogenated gas flowing at a rate such that a thickness of the resist layer increases while the oxide layer is etched.

21. A method of etching a substrate assembly comprising:

defining a pattern in a resist layer on a surface of the substrate assembly by exposing a portion of the surface;

selecting a gas or gas mixture;

exposing the substrate assembly to a plasma generated in the gas or gas mixture;

selecting a flow rate of the gas or gas mixture so that exposed portion of the substrate assembly is etched without thinning the resist.

22. The method of claim 21, wherein the flow rate of the gas or gas mixture is selected by measuring a rate at which thickness of the resist layer varies as a function of gas flow rate.

~~23~~. A method of etching a high aspect ratio feature having a controlled profile, comprising:

selecting a substrate assembly ;

selecting a surface of the substrate assembly to be etched;

selecting a depth D and width d of the high aspect ratio feature such that D/d > 10;

depositing a resist layer of thickness less than about D/5 on the selected surface of the substrate assembly;

etching the high aspect ratio feature into the selected surface with a controlled profile.

24. The method of claim 23, wherein the substrate assembly comprises a silicon wafer.

25. The method of claim 23, wherein the substrate assembly comprises a silicon wafer having a layer of silicon oxide on the selected surface.

26. The method of claim 23, wherein the thickness of the resist layer is selected to be less than about D/7.5.

27. The method of claim 23, wherein the thickness of the resist layer is selected to be less than about D/10.

28. The method of claim 23, wherein the thickness of the resist layer is selected to be less than about D/15.

29. A method of plasma etching a surface of a substrate assembly, comprising:

forming a layer of a resist on the surface of the substrate assembly;

patterning the resist by removing selected portions of the resist to expose corresponding portions of the surface of the substrate assembly;

exposing the resist layer and the exposed portions of the surface of the substrate assembly to a plasma etch;

etching the exposed portions of the substrate assembly at a rate that is at least five times faster than a rate at which the resist etches.

30. A substrate assembly comprising a surface with a high aspect ratio feature having a depth D and width w, wherein D/w is greater than about 10.

31. A substrate assembly according to claim 30, also including a resist layer covering the surface except at the high aspect ratio feature, the resist layer having a thickness d, wherein d/D is greater than about 1/10.

32. The etched substrate assembly of claim 30, further comprising a layer of a silicon oxide, wherein the feature is etched into the silicon oxide layer.

33. The etched substrate assembly of claim 30, wherein d/D is greater than about 1/20.

34. The etched substrate assembly of claim 30 having a controlled profile.

35. A method of plasma etching a surface of a substrate assembly having patterns defined by a resist layer, comprising:

enclosing the substrate assembly in a silicon or silicon carbide enclosure;

selecting a surface of the substrate assembly to be etched;

selecting a gas or gas mixture;

adjusting a flow rate of the gas or gas mixture into the chamber so that the resist layer etches at a rate that is at least 10 times slower than the etch rate of the selected surface;

exposing the substrate assembly to a gas flow; and

generating a plasma in the gas flow with an applied magnetic field.

36. A method of etching a substrate assembly, comprising:

selecting a gas or gas mixture;

providing a predetermined flow rate of the gas or gas mixture to an enclosure at a predetermined pressure;

maintaining the temperature of the enclosure at about 140 C;

patterning a surface of the substrate assembly with a resist;

situating the substrate assembly inside the enclosure;

heating or cooling the substrate assembly to achieve a substrate assembly temperature of about -10 C;

providing a silicon getter at a temperature of about 200 C within the enclosure;

producing a plasma in the gas or gas mixture in the enclosure with an applied radio-frequency excitation at a frequency of between 1 and 3 MHz;

exposing the substrate assembly to the plasma; and

etching the surface of the substrate assembly at a rate that is at least 10 time greater than a rate at which the resist etches.

37. A method of manufacturing comprising:

providing a substrate assembly having a first surface with a first surface feature;

removing material from at least one first region of the first surface; and

thickening material on at least second region of the first surface simultaneously while removing material from the first region.

38. A method according to claim 37 wherein the thickening step comprises depositing material on at least one second region of the first surface.

39. A method according to claim 37 wherein the removed material is an oxide material and the thickened material is a resist material.

40. A method according to claim 37 wherein the steps of removing material and thickening material are accomplished simultaneously by a plasma.

41. A method of manufacturing, comprising:

patterning a resist layer on a substrate assembly so that portions of the substrate assembly are exposed;

etching the exposed portions of the substrate assembly with a resist-conserving etch; and

etching the exposed portions of the substrate assembly with a resist-consuming etch.

42. A method of plasma etching a surface of a substrate assembly, comprising:

forming a layer of a resist on the surface of the substrate assembly, the resist layer having a nominal thickness t_N;

patterning the resist by removing selected portions of the resist to expose corresponding portions of the surface of the substrate assembly; and

exposing the resist layer and the exposed portions of the surface of the substrate assembly to a resist-conserving etch.

43. The method of claim 42, wherein the exposed portions of the substrate assembly are etched to a depth of at least $5t_N$.

44. The method of claim 42, wherein the exposed portions of the substrate assembly are etched to a depth of at least $10t_N$.

45. The method of claim 42, wherein the resist-conserving etch has a start-up loss and the nominal thickness t_N of the resist layer is less than twenty times the start-up loss.